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REPORT

of

The Infantry Board

SECRET

No. 1367

GRENADES, AT, M9A1 and M11A1.

FORT BENNING, GEORGIA

June 26, 1942.

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IB-471.6

June 25, 1942.

SUBJECT: Test of Grenades, AT, M9A1 and M11A1.

TO: Chief of Requirements Division,
Army Ground Forces,
Army War College, Washington, D. C.

1. References:

a. Infantry Board Report of Test No. 1312.

b. Letter, Infantry Board to Chief of Infantry, dated January 8, 1942 (IB-471.6).

c. Letter, Infantry Board to Chief of Requirements Division, Army Ground Forces, dated May 14, 1942 (IB-471.6).

d. Letter, Infantry Board to Chief of Requirements Division, Army Ground Forces, dated April 30, 1942 (IB-471.6).

2. The Infantry Board concurs in general in Sections VI and VII, Discussions and Conclusions, of the attached annexes Nos. 1 and 2, to Report of Test No. 1312.

3. The information relative to sight-setting and trajectories of the M9A1 and M11A1 grenades has been furnished The Infantry School for their use.

4. Attention is invited to deficiency in locking device on the Launcher M1, previously reported (Letter IB to Req. Div., dated April 30, 1942, IB-471.6-35), as indicated in paragraph 14 a, Annex #2, inclosed.

5. From all tests completed to date the M9A1 grenade has demonstrated its superiority to the M9 in every phase except anti-personnel effect, which is a distinctly secondary application of both grenades.

6. The Infantry Board recommends:

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a. That the M9A1 grenade be standardized as replacement for the M9 grenade, and substituted therefor; basis of issue to remain the same.

b. That the body of the M11A1 grenade be strengthened to increase its usefulness and durability as a training grenade.

c. That the Launcher M1 be modified as indicated in letter, Infantry Board to Chief of Requirements Division, Army Ground Forces, dated April 30, 1942, (IB-471.6-35).

For the President:

M. J. GUNNER,
Colonel, Infantry,
Director.

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REPORT of TEST

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GRENADE, ANTITANK, H.E., M9A1
(ANNEX NO. 2 TO REPORT OF TEST NO. 1312)

TEST SECTION
THE INFANTRY BOARD
FORT BENNING, GEORGIA

RESTRICTED

Submitted to
THE INFANTRY BOARD

Copy No. 6 **Date** June 11, 1942.

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TEST SECTION
THE INFANTRY BOARD
FORT BENNING, GEORGIA

JUNE 11, 1942

SUBJECT: GRENADE, ANTITANK, H.E., M9A1
(ANNEX NO. 2 TO REPORT OF TEST NO. 1312)

TO: THE PRESIDENT, THE INFANTRY BOARD, FORT BENNING, GEORGIA

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I AUTHORITY

1. See Report of Test No. 1312.

II PURPOSE OF TEST

2. To determine the relative characteristics of the Grenade, Antitank, H.E., M9A1 as compared to the Grenade, Antitank, H.E., M9.

III PERSONNEL

3. 1st Lt. Edward B. Crossman, Infantry, Test Section, The Infantry Board, conducted the tests and prepared this report.

IV INTRODUCTORY INFORMATION

4. This grenade has been called "Grenade, Rifle" and "Grenade, Antitank" in Report of Test No. 1312 and the 1st Annex thereto, the terms being used synonmously in those reports. The correct nomenclature has now been standardized as "Grenade, Antitank, H.E., M9A1" and "Grenade, Antitank, H.E., M9."

5. a. Results obtained with the M9 grenade were reported in Report of Test No. 1312, February 11, 1942.

b. Information obtained from firing a limited number of M9A1 grenades up to April 10, 1942, was reported in Annex to Report of Test No. 1312, dated April 10, 1942.

c. The present report gives results obtained from further firing of M9A1 and M11A1 grenades, in order to bring ballistic data up to date.

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6. Information below on sight settings, trajectory, etc., was obtained by firing M11A1 grenades, and was checked in part by firing M9A1 grenades.

7. The M11A1 practice grenade is identical in external appearance to the M9A1, with the exception of the painting and stenciling. However, the tail assembly does not have a fuze and the body of the grenade is empty. Screwed into the forward end of the tail assembly is a steel bar, so weighted as to give the M11A1 grenade the same ballistic characteristics as the M9A1. This bar is about 0.6" in diameter, weighs 0.35 lb. and extends into the body of the grenade about 4 inches.

V DETAILS OF TESTS AND RESULTS

8. Test No. 1.

a. Purpose: To determine sight settings for the M9A1 grenade.

b. Method: By firing M11A1 dummy grenades from a rest and adjusting the sights on center of impact. M9A1 grenades were fired at 37-1/2 yards as a check.

c. Results:

(1) For 25 yards: Set the peep at 1750; aim through the open sight just above the peep and over the top of the grenade.

(2) For 37-1/2 yards: Aim over the top of the drift slide and over the top of the grenade.

(3) For 50 yards: Use range marking 2650 on the sight leaf and aim over the top of the grenade.

(4) For 75 yards: Aim over the top of the sight leaf and over the top of the front sight.

(5) Markings on the sight leaf for above settings and aiming points:

(a) For 25 yards: 1875
(b) For 37½ yards: 2300
(c) For 50 yards: 2650

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(6) Note that in (1) and (2) above, with the peep set at 1750, definite aiming points on the slide assembly are available for 25 and 37-1/2 yards.

(7) By setting the peep for 2200 yards, two aiming points are available on the slide assembly: The open sight above the peep can be used for 37-1/2 yards and the top of the drift slide can be used for 50 yards.

(8) If the sight is set as in (6) above, range marking 2650 on the sight leaf must be used when the grenade is to be fired at 50 yards. If the sight is set as in (7) above, range marking 1875 on the sight leaf must be used when the grenade is to be fired at 25 yards.

9. Test No. 2.

a. Purpose: To determine angles of departure and trajectories of the M9A1 and M9 grenades.

b. Method: Sight settings obtained in previous firings were used to determine angles of departure. Angles of departure were used to determine trajectories. Calculated trajectories of the M9A1 were compared with measured trajectories of the M11A1.

c. Results:

(1) Angles of departure (approximate).

Range, Yards	Angle of departure M9	M9A1
25	2°20'	1°37'
37½	3°16'	2°33'
50	4°28'	3°33'
75	7°28'	6° 6'

(2) Trajectory, M9A1 grenade, figures in inches.

(a) Calculated from above.

Height at	Range 25	37½	50	75
25	0	15	31	72
37½	-22	0	24	84
50	-61	-31	0	75
75	-210	-167	-120	0

(b) Measured.

Range 50	75
36	70
25	83
0	73
	0

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(3) Trajectory, M9A1 grenade, figures to nearest foot.

Height at	Range 25	37½	50	75
25	0	1	3	6
37½	-2	0	2	7
50	-5	-3	0	6
75	-17	-14	-10	0

(4) Trajectory, M9 Grenade, calculated from angles of departure, figures to nearest foot.

Height at	Range 25	37½	50	75
25	0	1	3	7
37½	-2	0	2	8
50	-6	-3	0	8
75	-21	-16	-12	0

10. Test No. 3.

a. Purpose: To determine ranges and dispersion obtained with the M11A1 grenade when fired at various angles.

b. Method: By firing at a vertical target at ranges of 50 and 75 yards and by firing at angles of 30, 45, 50, 60, 70, and 80 degrees. Angles of 30 degrees and above were set by using a clinometer on the launcher.

c. Results: (1)

nge rds	Number of Shots	Dispersion, inches Vertical	Horizontal	Maximum	Time of flight, Seconds (approx)
50	3	14	32	34	1.0
75	4	24			
75	4	42	20	46	1.5

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ngle, egrees	Number of shots	Time of Flight, seconds	Average range, feet	yards	Dispersion, feet longitudinal	lateral	Dispersion % of range Long.	Lat.
30	3	5.6	688	229	60	5	8.7%	0.7
45	4	8.5	763	254	90	15	11.8	2.0
50	3	8.3	677	226	57		8.4	
60	3	9.7	684	228	19	5	2.8	0.7
70	3	9	404	135	57	36	14.1	8.9
80	3	10	247	82	5	15	2.0	6.1
	M/11 Grenade, fired under same conditions.							
45	3	7.3	585	195	36	10	6.2	1.7

ote: Lateral dispersion in some cases is excessive due to inaccurate method of sighting rifle laterally. Angles were measured with a clinometer on the launcher.)

VI DISCUSSION

11. a. In paragraph 8, Test No. 1, it should be noted that the peep sight may be set at either one of two points, when used with the M11A1 or M9A1. The peep may be set at 1750, which will then give two definite aiming marks on the slide assembly, one for 25 yards and one for 37-1/2 yards. When shooting at 50 yards, range marking 2650 on the sight leaf must be used. This is not as definite an aiming mark and is not so easy to use.

b. By setting the peep at 2200 yards, definite aiming marks on the slide assembly are available for 37½ yards and 50 yards. In that case range marking 1875 must be used when the range is 25 yards.

c. It is more difficult to use the range markings on the sight leaf than to use the definite aiming marks presented by the slide assembly. From the trajectory table it can be seen that the grenade will be only one foot high at 25 yards if the firer uses the sight setting for 37½ yards. In view of the other inaccuracies involved (range, errors of hold and aim, etc.) and the size of the target at which he is shooting, it is suggested that the peep sight be habitually set at 2200 yards with the M9A1 grenade. This will give definite sighting points for 37½, 50 and 75 yards. Where time permits, the firer can use range marking 1875 for 25 yards, but even if he uses the sight setting for 37½ yards the error will not be great at 25 yards.

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12. a. In studying the trajectory figures measured for the M11A1 grenade, it was noted that they differed markedly from the figures given for the M11 in Report of Test No. 1312. A recheck of data on the M11, as calculated from angles of departure and compared with similar data for the M11A1, showed that an error had been made in determining the original trajectory figures for the M11.

b. The trajectory figures for the M11 and M11A1 given in paragraph 9 c (3) and (4) of this report are accurate to the nearest foot, which is close enough for field conditions.

13. a. The body of the M11 practice grenade is made of heavy cast iron. When firing these, little damage was noted, except to the tail assemblies. In the firing conducted by the Test Section, only one M11 body was badly damaged, and that one was fired against armor plate.

b. The body of the M11A1 is made of light metal stampings. When firing these, damage to the tail was noted, as with the M11. Because of the light body metal, the body of the M11A1 was quite frequently damaged, especially the nose. M11A1 bodies were bent and battered even when fired into sand.

c. Unless a more satisfactory training grenade is supplied, it is evident that the training allowance of M11A1 grenades will have to be somewhat higher than the allowance of M11 grenades, due to the battering and denting of the present M11A1 body. Grenades with damaged bodies often can be fired, but the accuracy suffers.

d. Based on the recommended allowance of M11 grenades for training purposes, it is believed that when the M11A1 grenade is issued for training, three additional bodies should be provided and 5 tail assemblies per grenade. A separate letter has been written to this effect.

e. The Test Section recommends that the Ordnance Department develop a more durable M11A1 type of practice grenade.

14. a. During test firing with the M11A1 grenades, it was noted that the sight settings obtained did not agree with settings obtained in previous firing. On checking, it was found that the launcher body was not parallel with the bore of the rifle, but drooped.

b. A check was made with this and one other new launcher on four different M/1903 rifles and it was found that

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the amount of droop was practically the same for both launchers on all four rifles. This leads to the conclusion that this defect is one of manufacture.

c. The Test Section recommends that the launcher be modified in manufacture so that the body of the launcher is parallel to the barrel of the rifle when the launcher is on the muzzle and the clamping nut is set up tightly. A separate letter has been written to that effect, IB-471.6-35, April 30, 1942.

d. Further investigation along this line showed that the launcher could be bent through dropping the rifle and other abuse. The grenade is initially projected on a line which is the extension of the launcher center line. If the launcher is bent, the grenade will be discharged at an angle to the rifle bore, and will not hit the point of aim, with sight settings as given in paragraph 8, above.

e. The sight settings determined in paragraph 8 above were determined with the launcher parallel to the bore. If the launcher is not parallel, the sight settings above will not be correct and it will be necessary to change the setting or the point of hold in the opposite direction to that in which the launcher is bent.

f. The launcher, if not parallel to the bore, may be straightened by bending or by shimming with pieces of thin cardboard or other material. The Test Section has gotten satisfactory results by shimming the rear end of the launcher in the vicinity of the clamp.

g. The launcher may be checked by looking in the muzzle of the rifle with the bolt open. By getting the circle at the muzzle of the rifle bore concentric with the circle at the breech end of the bore, the eye is then on the center line of the bore. The circular mouth of the launcher should then be concentric with the bore if the launcher is correctly aligned. If it is not parallel, the rear end should be shimmed so that the circles are all concentric when the clamp is tightened.

h. Because of the ease of bending the launcher through carelessness or because of the possibility of the launcher not being manufactured so as to be parallel to the bore on all rifles, the Test Section believes that this matter should be discussed in the Training Manual on the launcher and that directions for straightening the launcher by shimming should be included in that manual. A separate letter has been written to this effect.

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VII CONCLUSIONS

15. The Test Section concludes that:

a. The sight settings for the M9A1 and M11A1 grenades should be:

(1) Set the peep at 2200 yards and use the top of the grenade as a front sight. For a range of

(a) 25 yards, use range marking 1875 on the sight leaf.

(b) 37½ yards, use the open sight just above the peep.

(c) 50 yards, use the top of the drift slide.

(2) For a range of 75 yards, use the top of the sight leaf and the top of the front sight.

b. Maximum range of the M11A1 is about 250 yards at an angle of 45°.

c. Trajectory figures for the M9, as given in Report of Test No. 1312 are incorrect. Corrected figures are included herewith.

d. The M11A1 practice grenade is not sufficiently durable to be satisfactory as a training grenade.

e. The launcher M1 must be checked by the soldier from time to time in order to insure its alignment with the barrel of the rifle.

H. G. SYDENHAM,
Lt. Col., Infantry,
Chief of Test Section.

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REPORT of TEST

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GRENADE, RIFLE, HE M9A1
(ANNEX TO REPORT OF TEST NO. 1312)

TEST SECTION
THE INFANTRY BOARD
FORT BENNING, GEORGIA

SECRET

Submitted to
THE INFANTRY BOARD

Copy No. 6 **Date** April 10, 1942

15285—BENNING, GA., 4-31-40—2,000

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TEST SECTION
THE INFANTRY BOARD
FORT BENNING, GEORGIA

APRIL 10, 1942

SUBJECT: GRENADE, RIFLE, HE M9A1
(ANNEX TO REPORT OF TEST NO. 1312)

TO: THE PRESIDENT, THE INFANTRY BOARD, FORT BENNING, GEORGIA

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I AUTHORITY

1. See Report of Test No. 1312.

II PURPOSE OF TEST

2. To determine the relative characteristics of the Grenade, Rifle, H.E. M9A1 as compared to the Grenade, Rifle, H.E. M9.

III PERSONNEL

3. 1st Lt. Edward B. Crossman, Infantry, Test Section, The Infantry Board conducted the tests and prepared this report.

IV INTRODUCTORY INFORMATION

4. There is some confusion regarding the correct nomenclature of this grenade. It has been called "Grenade, Antitank" and "Grenade, Rifle". The correct nomenclature is not known by the Test Section at this time. In this report the terms "Grenade, Antitank" and "Grenade, Rifle" will be used synonomously.

5. Letter, Chief of Infantry, February 11, 1942, CI-471.6/9060: "1. Recent demonstrations of the development type Antitank Grenade M9A1 have conclusively proved that this grenade has the following advantages over the standard Antitank Grenade M9:

a. Weight reduction to 19.8 ounces
b. Double penetration effect
c. Effective penetration at angle of incidence of at least 45 degrees
d. Ground detonation under all conditions of ground consistency.

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"2. Five of the Antitank Grenades M9A1, pointed ogive and domed ogive, have been sent to the Infantry Board. It is the opinion of this office that the domed type ogive is vastly superior to the pointed ogive type."

6. a. The types of grenades considered in this test are:

(1) The standard M9 grenade
(2) The M9A1 grenade, with domed ogive (round nose)
(3) The M9A1 grenade, with pointed ogive (pointed nose).

b. Four grenades M9A1 with pointed ogive and 1 grenade M9A1 with domed ogive were received for test.

c. The M9 grenade has a base detonating fuze which is fired by a long striker extending the length of the body from a protrusion of the nose cap. This striker is separated from the detonater by a safety pin extending laterally through the body, and which is pulled just before firing. See Plate #3.

d. The M9A1 has a base detonating, inertia fuze, completely contained in the tail assembly. A safety pin, pulled before firing, prevents accidental discharge. After the safety pin has been pulled, a light coiled spring prevents the inertia firing pin contacting the primer unless the forward motion of the grenade is suddenly stopped. See Plates 1, 2 and 8.

e. The exterior of the M9 grenade body has been turned and is of a different shape than the M9A1. (See Plate No. 4). It is believed that the body of the M9A1 is made of a stamping and is of lighter material.

f. The front end of the M9 is rather blunt, with the striker protruding about 7/16th of an inch, while the M9A1 has, in one case a long conical windshield or pointed ogive (Plate 1) and in the other case, a rounded windshield or domed ogive (Plate 2).

g. The tail assembly may be unscrewed from the body of the M9A1 grenade, taking with it the complete fuze assembly. The windshield may be forced off the body of the M9A1 grenade. (See Plate No. 8).

7. Weights and Dimensions.

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	M9A1 Domed Ogive	M9A1 Pointed Ogive	M9
Weight, total	1.22 lbs.	1.17	1.50
Length, overall	11.1 in.	11.1	9.5
Weight of nose cap	0.13 lbs.	0.08	
Weight of body	0.62	0.62	
Weight of tail and fuze assembly	0.47	0.47	0.31 (tail assembly)
Diameter of nose, cylindrical portion	1.82		
Diameter of flange	2	2	2
Diameter of body	1.77	1.77	2
Diameter of shank	0.94	0.94	0.94
Diameter of tail fin	2.125	2.125	2.125
Length of nose cap	2.70	2.70	0.47
Length of body	3.5	3.5	4.
Length of tail and fuze assembly	5.92	5.92	5.25
Length of fin	1.08	1.08	1.08
Depth of tail recess	3.75	3.75	4.31

V DETAILS OF TESTS AND RESULTS

a. Test No. 1.

a. Purpose: To determine the relative recoil of the M9 and the M9A1 grenades.

b. Method: The rifle was suspended by fine wires, with the butt resting against a heavy block. The rifle was fired and the distance the block moved was measured. An M11 grenade (similar to M9) and a modified M11 (giving same weight and same depth of seating on the launcher as the M9A1) were used.

c. Results:

	M11 (dummy) (similar to M9)	Modified M11 (Weight and seating similar to M9A1)	M2 Ball M2 A.P. Cal. .30
Distance block moved, average	47 inches	28½ inches	6 inches

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9. Test No. 2.

a. Purpose: To determine the relative penetration of the M9 and M9A1 grenades.

b. Method: One M9A1 grenade (pointed ogive) and one M9 grenade were fired at a 1" piece of armor plate, covered on the front with 2" of good concrete (1 part cement to 2 parts sand-gravel, well cured), reinforced with heavy wire mesh. Plate 14.

c. Results:

(1) The M9 grenade blasted a hole about 8" in diameter in the concrete and broke some of the reinforcing mesh. It made a hole in the steel plate about 3/8" deep. Plate 15.

(2) The M9A1 grenade blasted a hole about 9" in diameter in the concrete. It made a hole completely through the 1" steel plate, and about 3/8" in diameter. The reinforcing wire mesh was broken. Plates 16, 17, 18. Several fragments were blown through a paper screen set 6' behind the plate.

10. Test No. 3.

a. Purpose: To determine the penetration of the M9A1 grenade.

b. Method: By firing an M9A1 grenade at a 1" piece of armor plate, placed tightly against a 2" piece of armor plate, giving a total thickness of three inches.

c. Results: Due to incorrect sight setting, the grenade hit the upper edge of the 1" plate. It blasted a "U" shaped channel through the 1" plate, approximately 13/16" in diameter and blasted a hole approximately 5/16" in diameter through the 2" plate. The fragments tore a large hole completely through a 2" plank set several inches behind the plates. Plate 19.

11. Test No. 4.

a. Purpose: To determine the penetration of the M9A1 grenade.

b. Method: A piece of 1/4" armor plate was set 6" in front of a piece of 2" armor plate, giving a total thickness

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of 2-1/4", with 6" of air space between the two places. A 1" armor plate was set 16" behind the 2" plate. An M9A1 grenade (pointed ogive) was fired at the plates.

c. Results: The grenade blasted a hole approximately 1" in diameter through the 1/4" plate and blasted a hole approximately 5/16" in diameter completely through the 2" plate. The 1" plate, set 16" back, was considerably scarred and pock-marked over a diameter of 6", by the fragments blasted from the 2" plate. Plates 20, 21, 22.

12. Test No. 5.

a. Purpose: To determine fragmentation of the M9A1 grenade.

b. Method: The grenade was fired at a steel plate. Screens were placedon the flanks and front as shown on Page 6.

c. For results with the M9, see Report of Test No. 1312. The M9A1 grenade gave the following results:

(1) Within an angle of about 200 mils to the flanks of the point of impact fragments are effective to a range of 10 or possibly 15 yards.

(2) The danger angle measured from the face of the target toward the firer is 1300 mils.

(3) The safe angle in the direction of the firer is approximately 600 mils.

(4) In one instance the tail assembly was thrown to the right rear approximately 25 yards.

(5) The largest fragments are thrown out laterally, with fragments getting smaller and smaller as they approach the direction of fire. Thus at angles of 400 mils many fragments were large. From 400 to 800 many of the fragments were medium sized and from 800 to 1300 the fragments were very small.

d. Conclusion: The grenadier is safe to within about 10 yards of the point of impact. Personnel to the flanks of the point of impact are not safe.

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SECRET Average Fragmentation
3 Grenades M9 A1

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13. Test No. 6.

a. Purpose: To determine sight settings necessary with the M9A1 grenade (pointed ogive).

b. Method: Grenades were fired, center of impact noted and sights corrected accordingly.

c. Results:

(1) At 37-1/2 yards with the peep sight set at 1750 yards, the center of impact is obtained by sighting over the top of the drift slide and over the flange on the grenade body.

This is the same method of sighting as used with the M9 grenade, but with the M9 the peep sight is set at 2000 yards.

(2) Due to the limited number of grenades available, these figures may be open to doubt, and should be checked by additional firing of the adopted type of M9A1 grenade.

VI DISCUSSION

14. a. Since there were not enough grenades available to permit gathering complete data on the M9A1, several dummies were made up by turning M11 grenades to the same weight and approximate size as the M9A1 and by putting a plug in the tail to give the same depth of seating on the discharger. Sight settings obtained by use of these dummies did not agree with settings obtained by firing the M9A1 grenades, so the results of all tests with the dummies (except recoil) have not been included in this report.

b. Accurate figures on sight settings, time of flight, dispersion, maximum range, and trajectory will have to wait until sufficient M9A1 grenades of the adopted type (or suitable dummies) are available to permit adequate tests.

15. Since the M9A1 grenade is approximately 17% lighter than the M9, it would be expected to hit high with the same sight setting. However it is to be noted that the depth of the

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tail recess is approximately 9/16 less on the M9A1, giving a shorter depth of seating on the leauncher. This should reduce the velocity somewhat, partially balancing the effect of the light weight.

16. a. The recoil of the M9A1, as indicated by paragraph 8, is less than that of the M9. The results of Test No. 1 are qualitative rather than quantitative, but they indicate that the recoil of the M9 grenade is several times that of a .30 caliber ball cartridge, which is borne out by firing from the shoulder. The recoil of the M9A1 is considerably less than that of the M9, due to the lighter weight and the shorter seating on the launcher. However it is still considerably more severe than the recoil of a ball cartridge. From the recoil figures it is estimated that the recoil of the M9A1 is approximately 40% less than the recoil of the M9 and about 5 times the recoil of ball ammunition.

b. The data relative to number of rounds which can be fired, given in paragraph 17, Report 1312, can probably be revised upward in view of the lighter recoil of the M9A1.

c. It may be possible to eliminate the use of the rubber recoil pad when the M9A1 grenade is used. More data should be gathered by firing of actual M9A1 grenades before a definite recommendation can be made on this point.

17. a. Maximum penetration of the M9A1 grenade is not known, as the three grenades which hit the plates (Par. 9, 10 and 11) blasted holes completely through the plates under test. It is believed that thicker plates could be penetrated, but how much thicker is not known.

b. It has been reported that some German tanks are being covered on vital spots with a two inch layer of concrete over the armor plate in an effort to reduce or eliminate penetration by antitank weapons. From paragraph 9 it is to be noted that two inches of good concrete over a one inch armor plate is not sufficient to stop the M9A1 grenade. It is also to be noted that the M9 grenade was stopped by this combination.

c. An airspace, as described in Par. 11, has been suggested as one method of nullifying the effects of this grenade. The results of Test No. 4 indicate that the grenade

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is still very effective even though it is detonated 6" from the armor plate.

18. a. It is not believed that the M9A1 grenade will be as effective as the M9 when used against personnel, because of the lighter material from which the body is made. In Par. 12 many of the hits recorded on the screens were made by tiny fragments of metal, the majority of which would not be casualty-producing, although they might make a man somewhat uncomfortable. All holes were rather jagged, and the largest was about 1/2" across its maximum diameter. The number of holes 1/4" or larger was rather small. The larger fragments were thrown to the side.

b. The lighter body material of the M9A1 not only produced smaller fragments but a smaller number of fragments, consequently the danger range is somewhat less than with the M9 grenade, roughly one third to one quarter less. However, despite this, it is believed that the M9A1 may be a useful weapon against personnel.

c. Test No. 5 is indicative, but not positive. More information should be gathered on this subject.

19. a. The inertia type firing mechanism is superior because any sudden checking of the forward motion will give detonation. It is not necessary for any particular portion of the grenade to strike the surface, as is the case with the M9. Report 1312, par. 8 and 9, cites three instances where M9 grenades failed to detonate because the striker did not contact the surface. The M9A1 grenade would have detonated in these instances.

b. It is not known how severe the slowing of the forward motion must be in order to detonate the M9A1, i.e., whether it will fire on hitting grass, brush, twigs, etc. Due to the weight of the grenade, it is believed that it must strike a fairly substantial surface to secure detonation, but no data is available on this matter.

20. a. The Launcher, M1, slips over the muzzle of the 1903 rifle, stopping against the forward side of the front sight. It is held by a wing nut which clamps a band around the barrel in rear of the front sight. The forward edge of the band clears the rear side of the sight by about 1/2 inch.

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b. When firing with ball ammunition, the force of the gas and the force of the recoil tend to move the launcher forward on the gun. When firing the grenade, the gas forces the launcher to the rear on the rifle.

c. While firing tests with ball ammunition the launcher slid forward until the clamping band was against the rear face of the front sight. This allowed the launcher body to slip off the barrel and droop down in front of the muzzle. When the next cartridge was fired, the bullet struck the inside of the launcher, bulging and damaging it. Plate 26 and 27.

d. This defect in design can be easily remedied by widening the clamping band which goes around the barrel in rear of the sight. Plate 28.

e. Since the rifle in combat will undoubtedly be fired with ball cartridges when the launcher is on the rifle, the Test Section believes that this is a serious defect which should be remedied by redesign. Launchers already manufactured and similar to the one in the possession of the Test Section, should be modified in some simple manner.

21. Due to the limited number of grenades available, the Test Section was not able to gather any data on the relative merits of the pointed ogive versus the domed ogive.

22. The Test Section concludes:

a. That the M9A1 rifle grenade is far superior to the M9 rifle grenade when used as an antitank weapon.

b. That the M9 rifle grenade is superior to the M9A1 rifle grenade when used against personnel.

c. That the recoil of the rifle (M-1903) is about 40% less when firing the M9A1 that when firing the M9 rifle grenade.

d. That the required sight settings of the M1903 rifle for use in firing the M9A1 grenade are approximately as follows:

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FOR 37-1/2 YARDS SET THE PEEP SIGHT AT 1750 YARDS, SIGHT OVER THE TOP OF THE DRIFT SLIDE AND OVER THE FLANGE ON THE GRENADE.

2. That the Launcher M-1 must be modified to prevent it moving forward and dropping down in front of the muzzle when firing Cal. .30 ammunition. (A modified sample is being submitted separately.)

H. G. SYDENHAM,
Lt. Col., Infantry,
Chief of Test Section.

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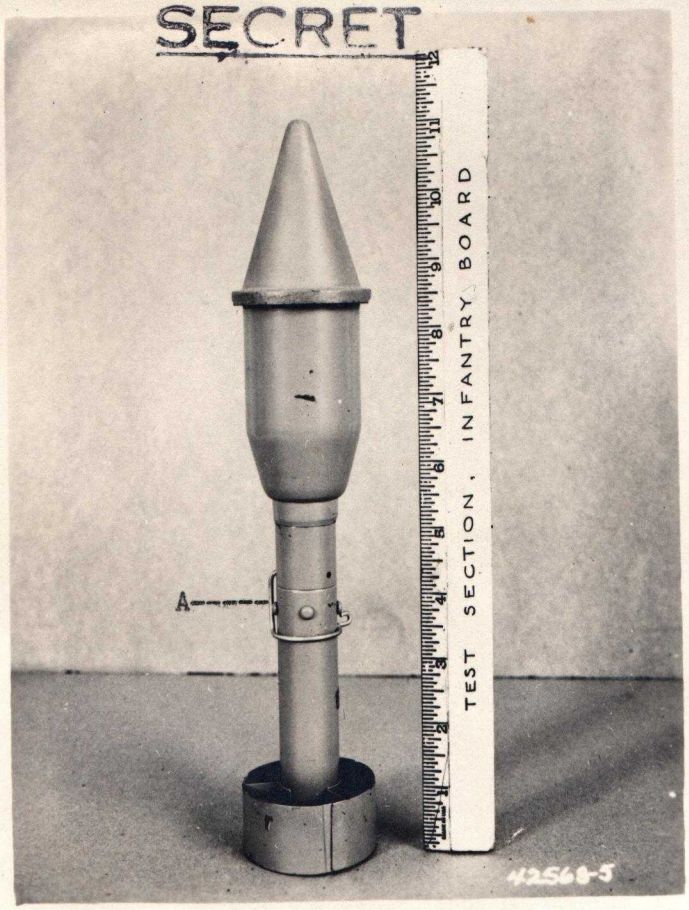

Grenade, Rifle, HE, M9A1, with pointed ogive.

Same construction as grenade shown in Plate 2, except for shape of windshield or nose-cap.

A - New type safety pin. Note that pin is in tail assembly.

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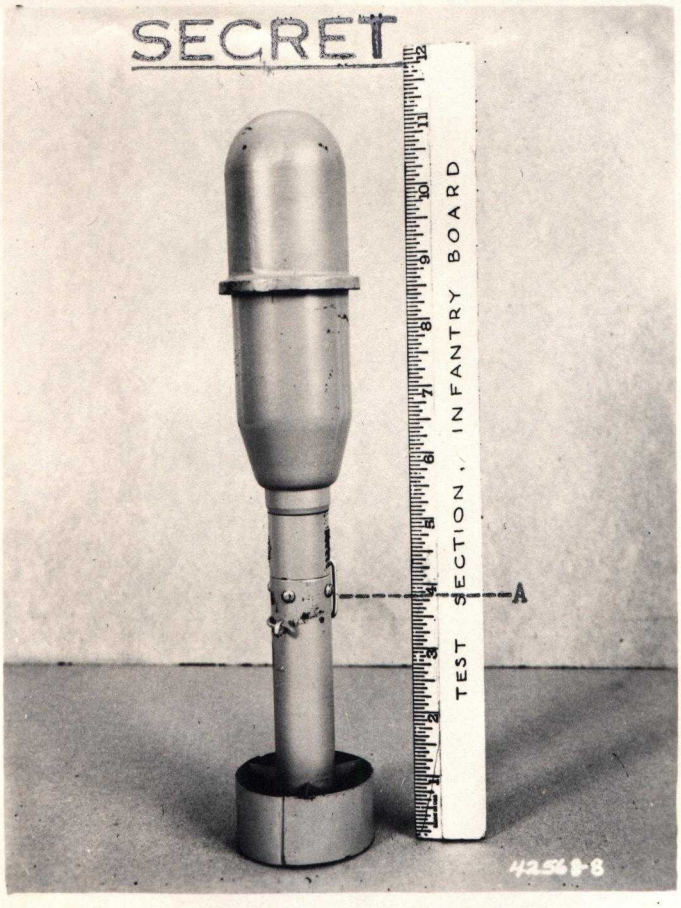

The M9A1 rifle grenade with domed ogive.

Also see Plate 1.

A - New type safety pin in tail assembly.

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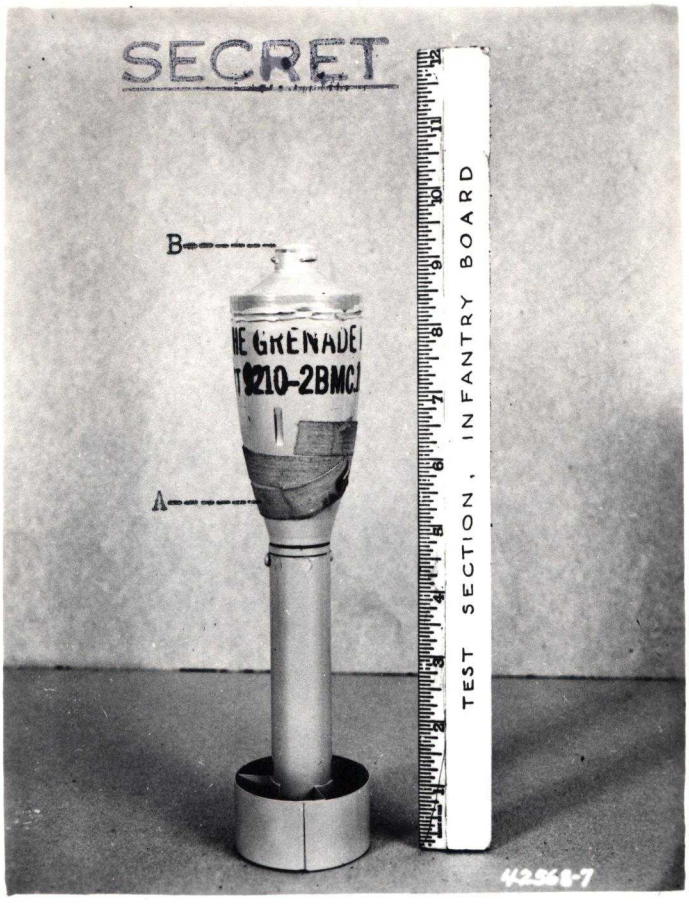

The M9 Grenade.

A - Tape holding safety pin in place. Note that pin is in body of grenade.

B - Striker protruding through the nose.

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PLATE 3

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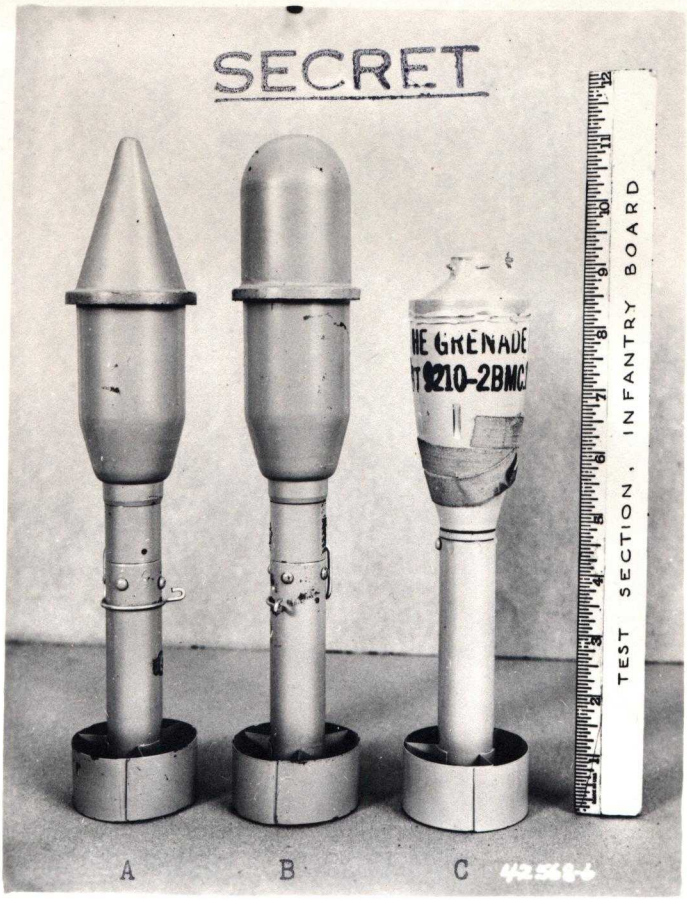

A - The M9A1 grenade with pointed ogive.

B - The M9A1 grenade with domed ogive.

Although longer, the M9A1 weighs about $\frac{1}{4}$-pound less than the M9.

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The two versions of the M9A1 Grenade.

A - Pointed ogive.

B - Domed ogive, reputed to be superior to the pointed type.

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Rear View of the M9A1 Grenade

A - Pointed ogive type.

B - Domed ogive type.

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Front View of the M9A1 Grenade.

A - Pointed ogive type.

B - Domed ogive type.

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PLATE 7

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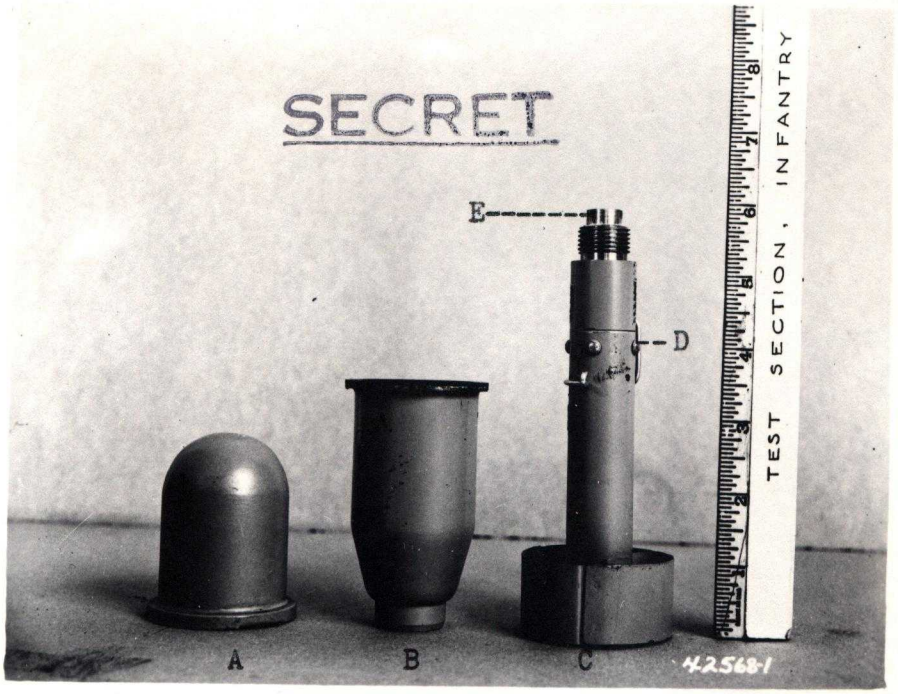

The 3 major assemblies of the M9A1 grenade.

A - The hollow nose cap or windshield, made of light metal. The domed ogive shown here.

B - The grenade body with explosive contained in it.

C - The tail assembly, containing the fuze assembly.

D - The safety pin in the tail assembly.

E - The booster or detonator.

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The M9A1 grenade with pointed ogive on the grenade launcher, M1.

The M1 launcher can be mounted on the Model 1903 or Model 1917 Rifles.

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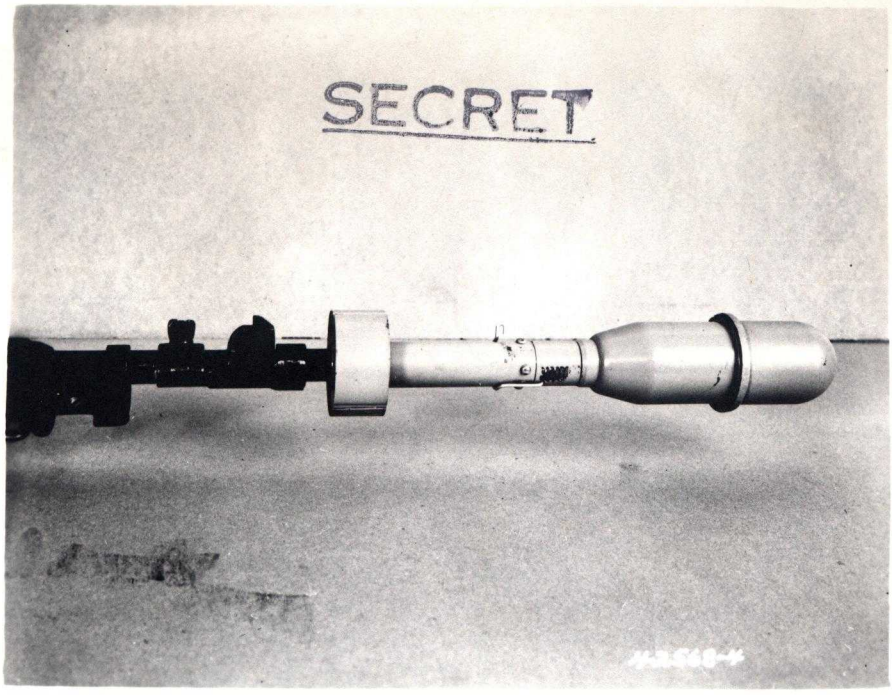

The M9A1 grenade with domed ogive on the grenade launcher.

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PLATE 10

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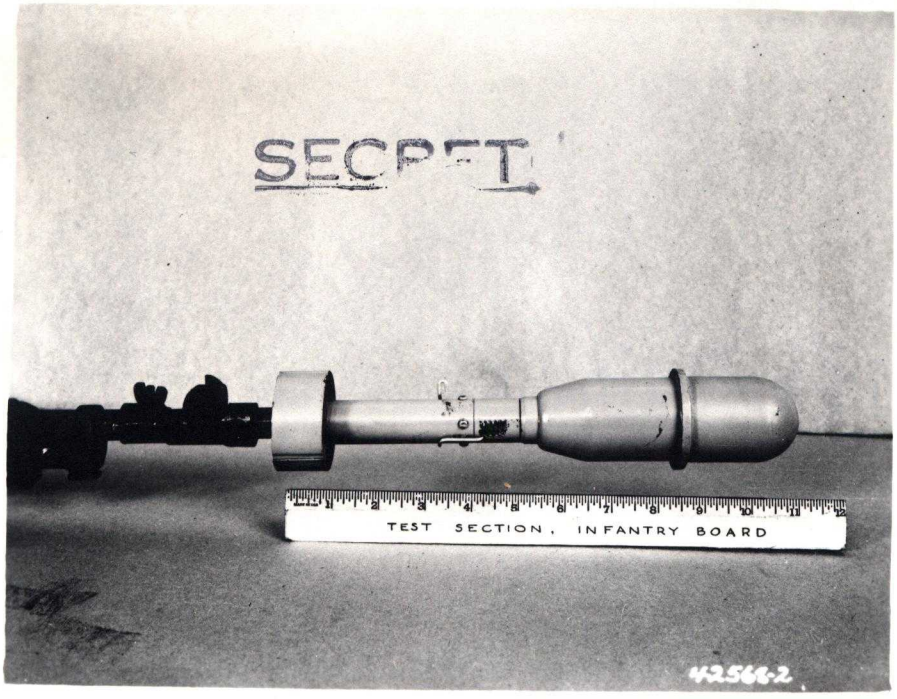

The M9A1 domed ogive grenade on the launcher.

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PLATE 11

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The concrete-steel plate set up at 50 yards.

6' x 6' screens to rear and rear flanks of plate.

A - The plate.

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PLATE 12

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A Hit.

The concrete-steel plate at 50 yards.

Note dust raised on the flanks by the lateral fragmentation.

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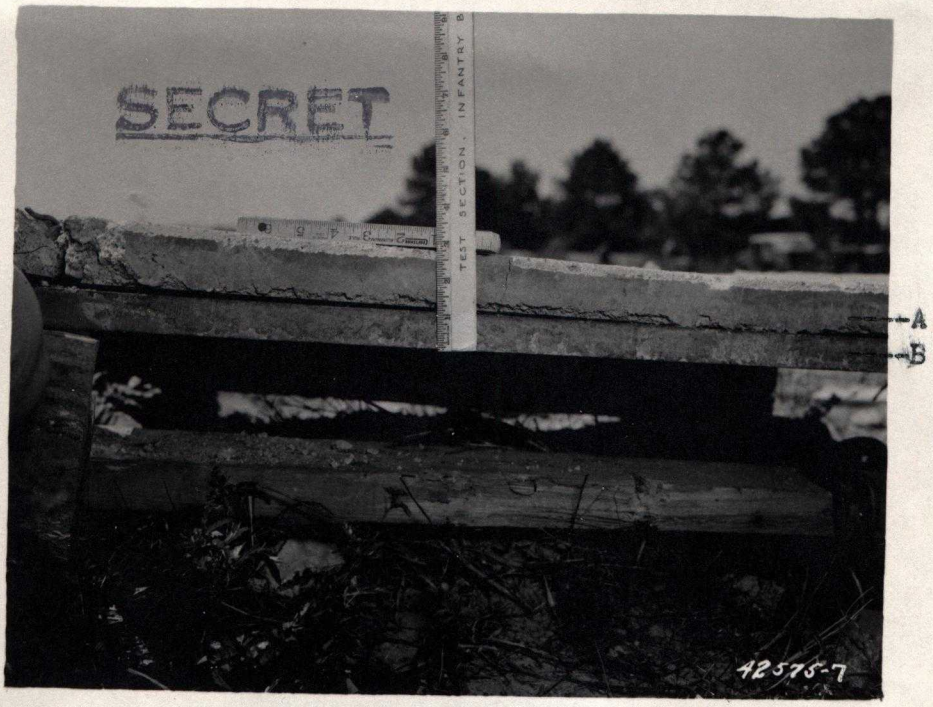

Edge view of the concrete-steel plate.

A - Front face of well cured, high-quality concrete, 2 inches thick.

B - Backing plate of 1 inch armor plate.

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Blasting effect of the M9 grenade. Fired against 2" concrete backed by 1" armor plate.

Armor plate penetrated to depth of about 3/8".

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Effect of the M9A1 grenade on concrete-steel plate.

Note lateral fragmentation pattern on face of concrete and 2" x 6" plank.

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Effect of the M9A1 grenade on 2" concrete backed by 1" armor plate.

A - Hole blasted completely through armor plate.

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Rear side of the concrete-steel plate.

A - Hole blasted through 1" armor plate, after penetrating 2" of concrete. Made by the M9A1 grenade (pointed ogive).

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Armor plate 1" thick placed against a 2" armor plate and hit by a M9A1 grenade.

A - Hole blown through both plates. (Total thickness, 3".)

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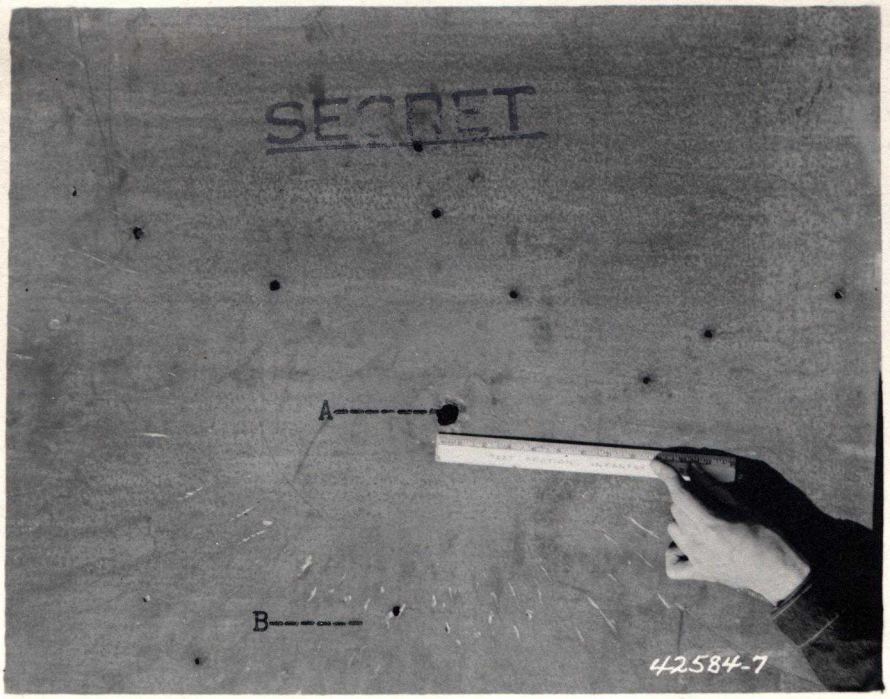

Test No. 4, Paragraph 11.

The ¼-inch armor plate, hit by an M9A1 grenade.

A - Hole made by grenade.

B - Note fragmentation pattern.

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Test No. 4, Paragraph 11.

The 2" armor plate, set 6" behind the ¼" plate.

A - Hole completely through 2" plate.

B - Pock-marking of plate face by fragments of ¼" plate.

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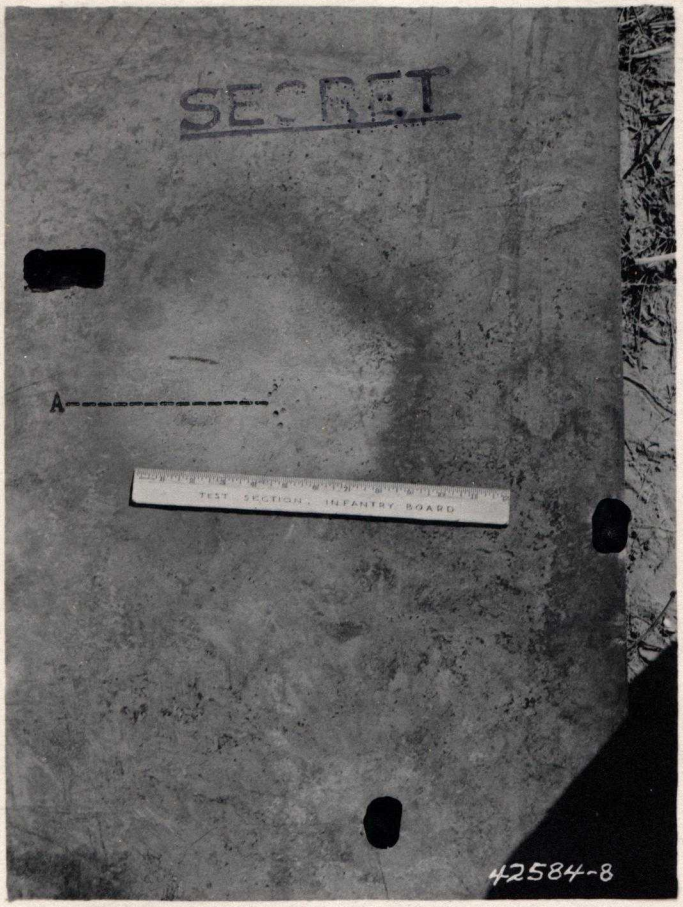

Test No. 4, Paragraph 11.

The 1" plate, set 16" behind the 2" plate.

A - Pock-marking of plate face by fragments from 2" plate.

Note area of blast and fragmentation.

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A hit at 37½ yards.

Note fragmentation screens at various distances from the plate.

A - Dust raised by fragments.

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Dust after a burst at 37½ yards.

A - Armor plate.

B - Dust raised in front of plate by burst and fragments.

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Photo of a burst at 37½ yards.

Plate can not be seen.

A. Note dust raised on flanks by fragments.

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Launcher M1 with narrow clamp, in forwqrd position, as a result of firing ball cartridges.

Note that launcher has dropped down in front of the rifle bore.

A - Standard, narrow clamp. Should be modified.

B - Note gap between muzzle and launcher.

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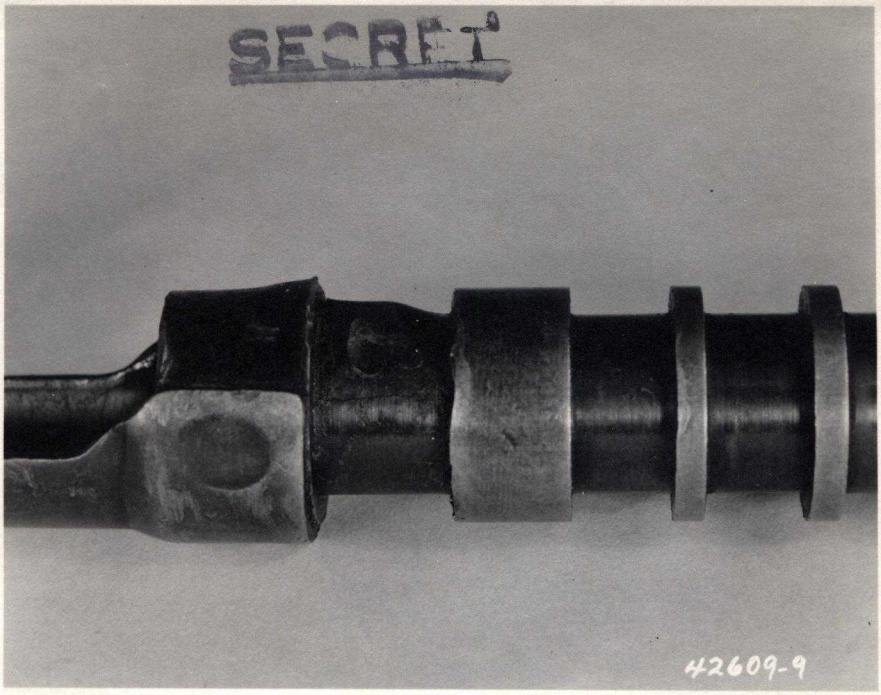

Bulge in M1 launcher. This is the result of firing one round of ball cartridge after the launcher had slipped off the muzzle.

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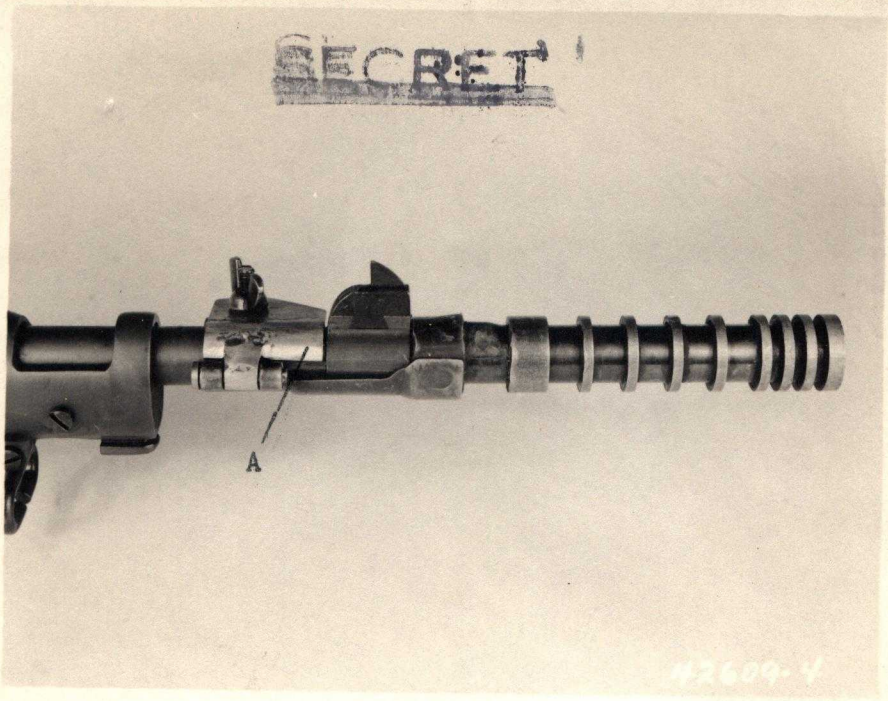

The M1 launcher with modified clamp.

A - Experimental clamp, approximately 7/16" wider toward the front. This prevents the launcher moving far enough forward to slip off the muzzle.

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